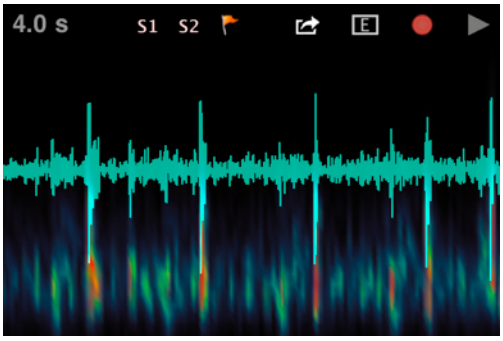
Thinklabs®

Stethoscope App 1.0



for iPod Touch and iPhone

Raising the Power of the Stethoscope

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Quick Start - If you never read manuals

Stethoscope App is extremely intuitive to use. Nevertheless, it has many features and we recommend that you read this Manual to learn the full power of the App. However, we know you'd like to get started immediately, so here is a very quick introduction for those who are very familiar with iPhone / iPod Touch.

1. **Install** - Download Stethoscope App to your iPhone/Touch.
Stethoscope

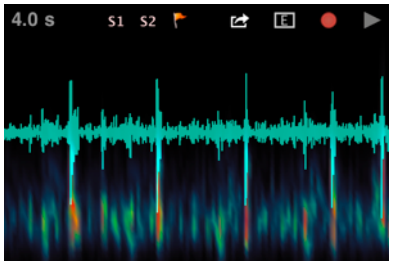
2. **Audio Source** - use either default input (mic on iPhone, none on Touch), external mic, or connect a stethoscope via an accessory compatible with iPhone/iPod Touch.

3. **Record** - Tap and default Audio Source will be recorded with real time display.
Stethoscope

(iPod Touch screen will be black unless an external mic/audio source is connected.)

4. **Stop/Pause/Review** - Tap screen anywhere to Stop/Pause Recording.

Use Multi-Touch gestures to scroll and zoom

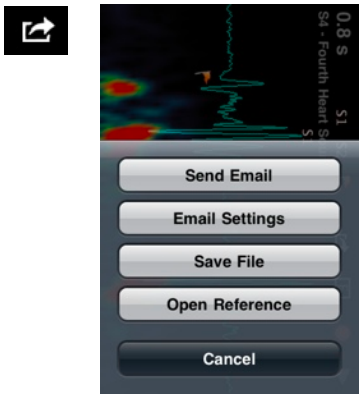


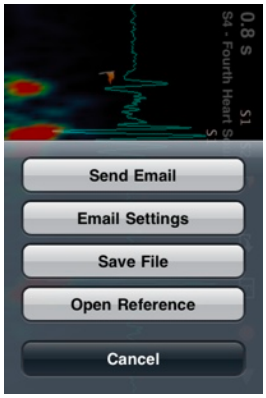
Play (loops display segment)

Continue Recording

HIGH AUDIO PLAYBACK QUALITY REQUIRES GOOD, SEALED HEADPHONES

5. **Save / Email** - Menus provide options for Saving or Emailing Recordings.





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Instructions for Use

Setup

1. Purchasing/Downloading Stethoscope App

Purchase Stethoscope App from the Apple 'App Store'. Go to http://www.itunes.com/app/ (TBD) and search for 'Thinklabs'. You can install the App on any iPhone or iPod Touch (2G) using OS 3.1 or later. For general information on downloading apps, see Downloading Apps.

Once you have downloaded Stethoscope App, you will see Stethoscope App's icon (right) on your iPhone/Touch screen. (There can be multiple screens of apps on your device. Scroll Home screens to find the App if necessary.)

Stethoscope

2. Hardware - stethoscope and audio input accessory

You can test the App without a stethoscope or other hardware, to familiarize yourself with the controls. When a stethoscope is not connected, the App simply accepts input from the default audio source, such as built-in mic on the iPhone. On the iPod Touch, the recording screen will be blank, but when you touch the screen to stop recording, the controls and menus will appear normally and you can navigate the App.

To listen to heart sounds, breath sounds and other body sounds, use a compatible electronic stethoscope. The Thinklabs ds32a Digital Stethoscope, in conjunction with an audio input accessory compatible with the iPhone/Touch, will provide excellent results.

Thinklabs ds32a Digital Stethoscope

Simply connect the audio input accessory to the iPhone/Touch and connect a stethoscope to the input on the accessory using the cable supplied with your stethoscope. Note that not all electronic stethoscopes have the required output to use Stethoscope App.

Please contact us for more information and we can assist you in getting the best solution for your needs.

3. Playback

Connect high quality sealed eartip headphones or suitable stethoscope to the headphone jack for proper reproduction of body sounds. Open style headphones or loudspeakers are inadequate for such low frequency sounds.

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Using Stethoscope App

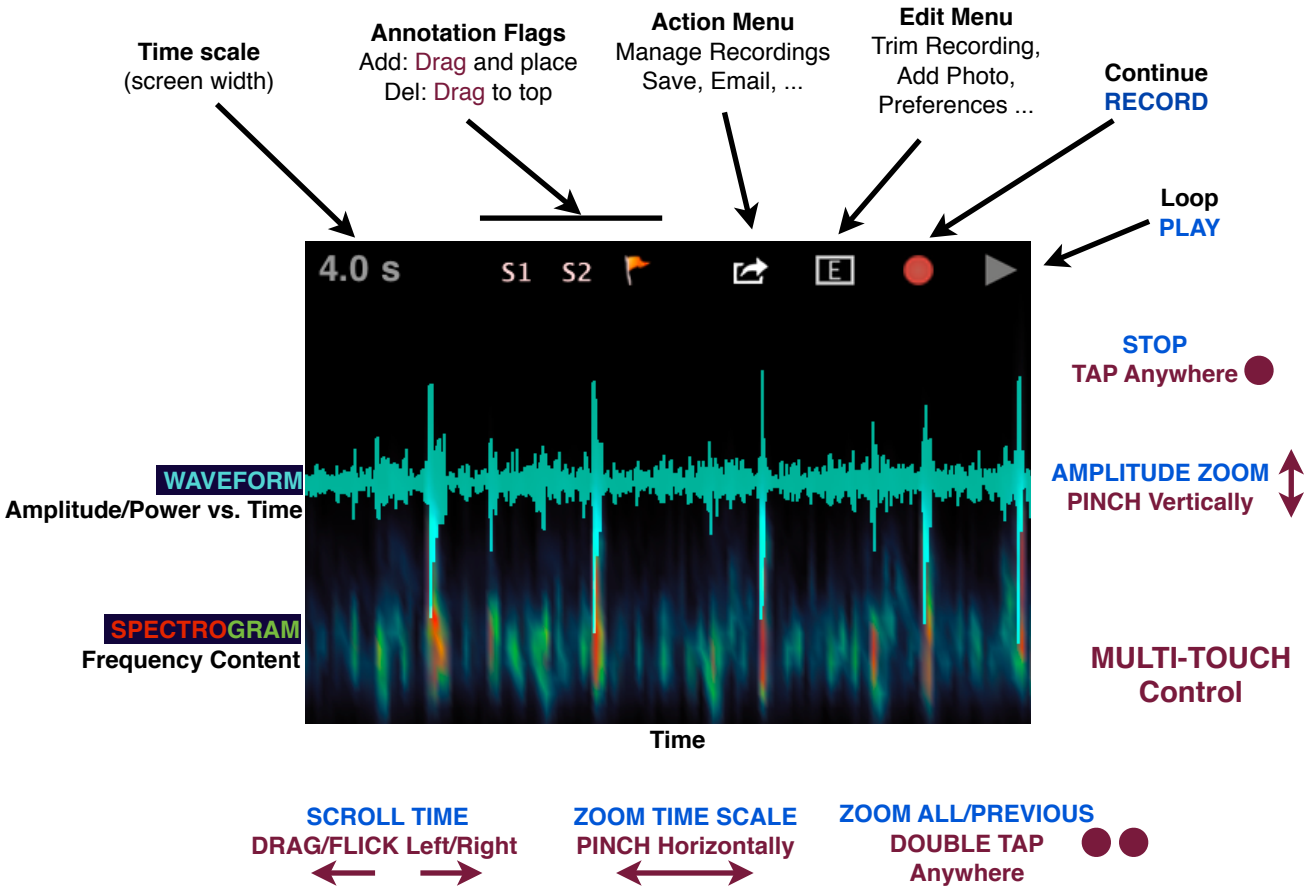
1. **Start Recording - TAP** to launch Stethoscope App and Start Recording.

Stethoscope

The launch screen (right) will appear briefly, followed by a **real-time display** of the recording waveform. You are now recording! The App will capture the **previous 20 seconds** of sound.
(If recording accessory is not connected to the iPod Touch, a black screen will appear with no sound recording.)

2. **Stop/Pause Recording - TAP** the screen to Stop/Pause Recording. The screen below will appear and you can now Manage your Recording.

3. **Manage Your Recording -** The Figure below provides a Quick Reference of Stethoscope App's features. Explore menus and functions, especially MULTI-TOUCH Controls. Refer to later sections for further details.



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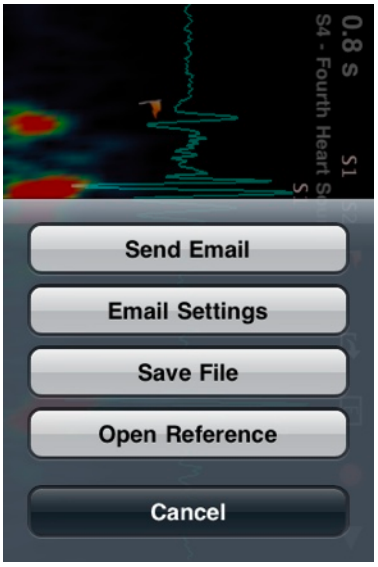
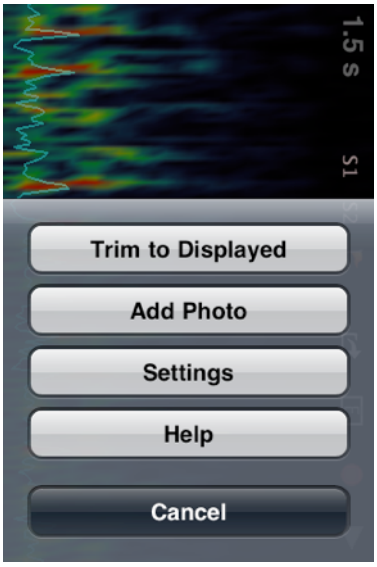
Action Menu

Send Email	Send Email of sound, plots and notes. Opens a new Email, attaches screen image and other waveform images (.png) and attaches audio file (.wav). Add notes to the email and Send. (Email must be set up on your iPhone/Touch)
Email Settings	Set up default settings for emails, such as default recipients, subject, notes, and which plots are attached. Send Email then creates emails with entries already set, to save time.
Open File	Open a previously Saved Recording. "Open File" only appears when there are Saved files.
Save File	Save the current Recording, with Title and Notes.
Open Reference	Open a Reference Recording - files provided with Stethoscope App as example Recordings.



Edit Menu

Trim to DIsplayed	Cuts the Recording to only that portion which is currently on the screen. Trim will remove any recording to the left of right of the currently displayed waveform.
Add Photo (iPhone only)	Starts the Camera App so a photograph can be taken and added to an Email.
Settings	Same as Email Settings above.
Help	Stethoscope App Help information.



Sound Display - What the waveforms show

For an explanation of the waveforms and Spectrogram display of sounds, please see the discussion on Pages 9-12. Time Waveform and Spectrogram are overlaid on the screen. When reports are emailed, Waveform and Spectrogram are plotted separately.

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Recording Tips

- When recording from the Thinklabs ds32a Digital Stethoscope, make sure the ds32a is powered on, and you can hear the heart or other sounds you are targeting. The stethoscope powers off automatically in 2 minutes. This setting can be changed to up to 5 minutes. See http://www.thinklabsmedical.com > Support > Manuals.
- Hold the stethoscope probe steady on the chest, making good skin contact when recording. Listen and watch the display simultaneously until you have a few seconds of clean consistent recording. Then TAP the screen to STOP recording.
- Recording continues indefinitely, but Stethoscope App only saves the last 20 seconds.
- To continue recording, press Record ● . Stethoscope adds a short silent gap, the continues recording. Consider Trimming the recording before continuing, to delete unwanted segments, however be careful not to trim desired sound.
- Listen to your recording by connecting a ds32a Stethoscope or high quality sealed headphones into the headphone jack on your iPhone/Touch. Stethoscope App always loops through what you have on the screen, so Zoom to listen to one segment repeatedly, or expand the display with a Double Tap to hear the entire recording.
- If you are looking at a Saved or Reference file and press Record, Stethoscope App starts from scratch and makes a new recording.
- While recording, Stethoscope App always shows a 4 second wide window. After recording, zoom into the phonocardiogram using multi-touch gestures. See Page 5.
- **Trimming Recording -** After recording, you may have unwanted segments, such as a a noisy start, as you were adjusting the stethoscope, etc. At the end of the recording there might be a small segment of noise as you remove the stethoscope Tap to stop recording. To Trim the recording, Zoom to show the desired segment of sound and select Edit > Trim to Desired. Any non-displayed parts of the recording will be deleted.
- Time Display - The top left corner always show the scale of time being displayed on the screen.

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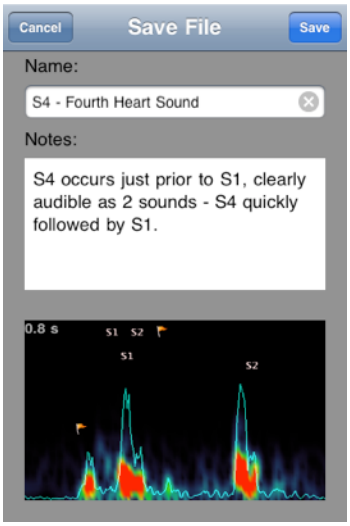
Saving and Opening Files

After recording, you can save the sound and images into a file stored on the iPhone / Touch. You can then Open and review or email saved files. You email a saved sound by simply opening it, then emailing it.



To save a file use the Action menu, and select ‘Save File’. A dialog appears allowing you to name the file (a date based name is automatically filled in, but is easily overwritten), and enter notes.

The file is saved so that later opening it will bring you back to the file exactly as you saved it. You can save as many files as you like, however it is recommended that you email files and limit the number of files saved on your iPhone / Touch.

You can modify a previously saved file by opening it, making changes and saving it with the identical filename.

To open a file for viewing, tap > “Open File” or “Open Reference”. “Open File” allows you to open a file that you saved, while opening a Reference File allows you to open files that are included with Stethoscope App. You can delete saved files from your iPod with the ‘Edit’ button at the top right of the Open File screen. Deleted files cannot be recovered. The small icon pictures next to the descriptions are based on Stethoscope’s screen at the time you saved the file.

Any notes you add to a saved file will be included in emails sent of the saved file.

Saved files are backed up when syncing the iPod on a desktop or laptop computer.

Reference files can be opened, viewed and played, but not deleted.

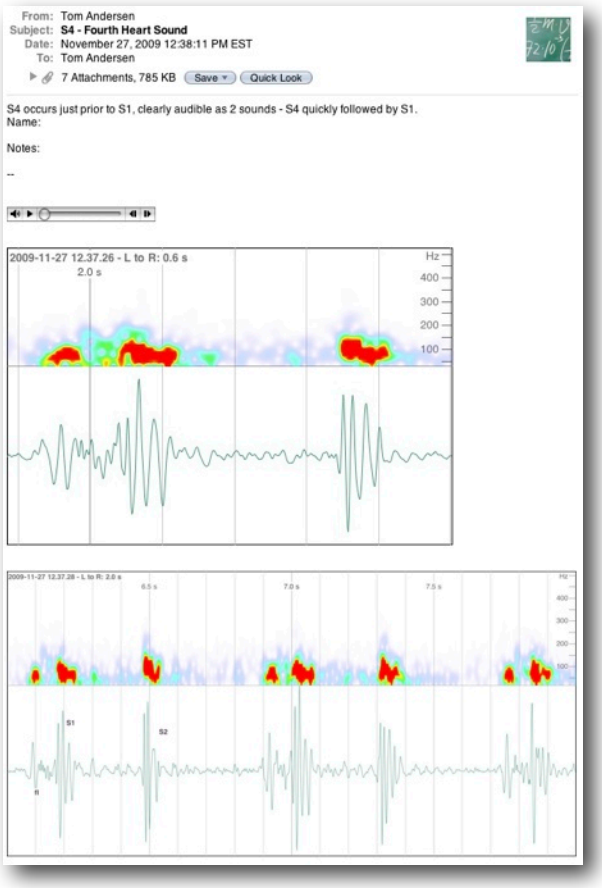
Emailing

Stethoscope App can email recordings effortlessly. Emails automatically attach the .wav sound file and images that are ready to print.

Using Email

Email needs to be set up on the iPod/iPhone - Stethoscope App will not show the email items in the Action menu unless email has been set up on the iPhone / Touch. Launch the 'Mail' application and follow the instructions.

Once email is set up, you can use Stethoscope App to send emails. Your iPod Touch or iPhone does not have to be in a WiFi or other wireless mode to use this feature - unsent emails will be saved in your Outbox and sent when the device finds an internet connection at some later time. This allows you to use the email feature in locations with no wireless service.



You should set up the Email Settings with default email addresses and notes, to save time if you always send emails to the same recipient(s). The '+' buttons allow you to pick an email address from your contacts.

The emails sent by Stethoscope App include a 'wav' formatted sound file which can be opened/played on any computer or music device, and several graphs in 'png' format, which makes them simple to print and share.

You can edit the notes and other data in the email. You can also delete unneeded graphs or photos prior to sending.

Graphs

The graphs attached to emails are labeled in 0.1 Second intervals, with the time 0.0 seconds corresponding to the start of the sound wav file. The first graph in the email always shows the screen view (zoom level) when the email was sent. Use this feature to select a view that clearly shows the most relevant segment of the recording, before sending your email.

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Graphs are labeled in the upper left corner showing date/time along with the left to right width of the graph in Seconds. File names are shown for any saved files.

Graphs have distinct regions for waveforms and spectrograms (frequency content). On the iPhone/Touch display these are shown overlaid in the same screen area, but with the added space on a printed report, the regions are separated.

Note that graphs are attached to emails in a form ready to print, with a white background rather than the dark background on the screen version. The purpose is to facilitate economical printing.

Sound Data - Waveform (Phonocardiogram) / RMS Power

The green/turquoise colored plot on the screen can show either the time domain waveform (phonocardiogram) of sound Amplitude vs. Time, or RMS Power vs. Time.

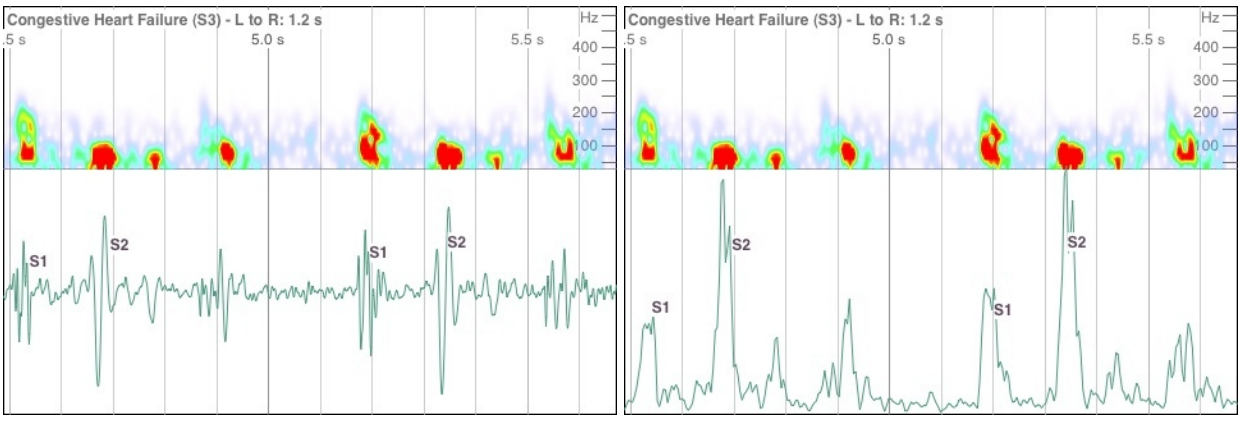
Normal mode - Amplitude vs. Time (Phonocardiogram)

In Normal mode (RMS 'off' in the Settings), Stethoscope App shows a line graph of the sound signal as recorded over time. This is the typical display of phonocardiograms seen in textbooks.

RMS Power mode

In RMS mode (RMS 'on' in the Settings), Stethoscope App shows the instantaneous signal power. This setting can potentially produce easier to read graphs, as extraneous information tends to be suppressed by power signals. The RMS power more closely approximates what you actually hear - the rise and fall of sound intensity.

The graphs show the same sound in each mode - Normal (left), RMS Power (right):



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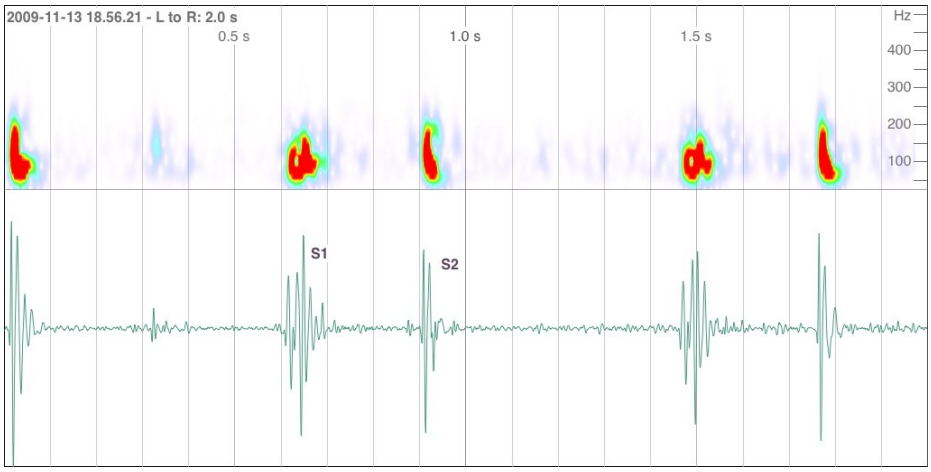
Spectrogram (Power Spectrum)

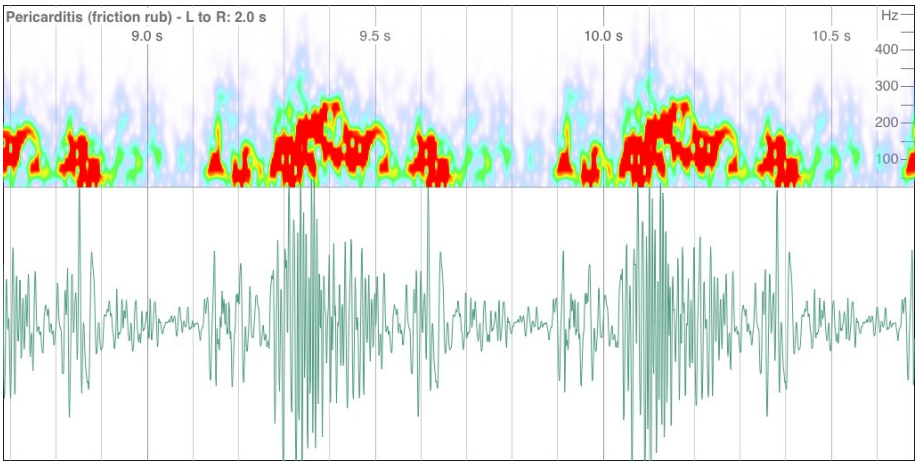
The Power Spectrum (Spectrogram) is shown below. Spectrograms show both the Frequency (tone) of a sound and the Power/Intensity of the sound.

Frequency is shown on the vertical axis to the right of the plot - the higher the tone, the higher the bright color will be on the plot. In the example below, the frequencies of S1 and S2 are extremely low, as expected.

The Power / Intensity of the various frequencies is shown by color spectrum - purple-blue represents lower energy levels and yellow-orange-red show increasing levels of signal energy. In the plot below, the low frequency energy is greatest during S1 and S2. If additional sounds, such as S3 or S4 are present, one would expect to see evidence of low frequency energy at times other than S1 and S2. (See plot, next page).

The plot below shows a normal heart (10 year old), followed by a condition known as Pericarditis.





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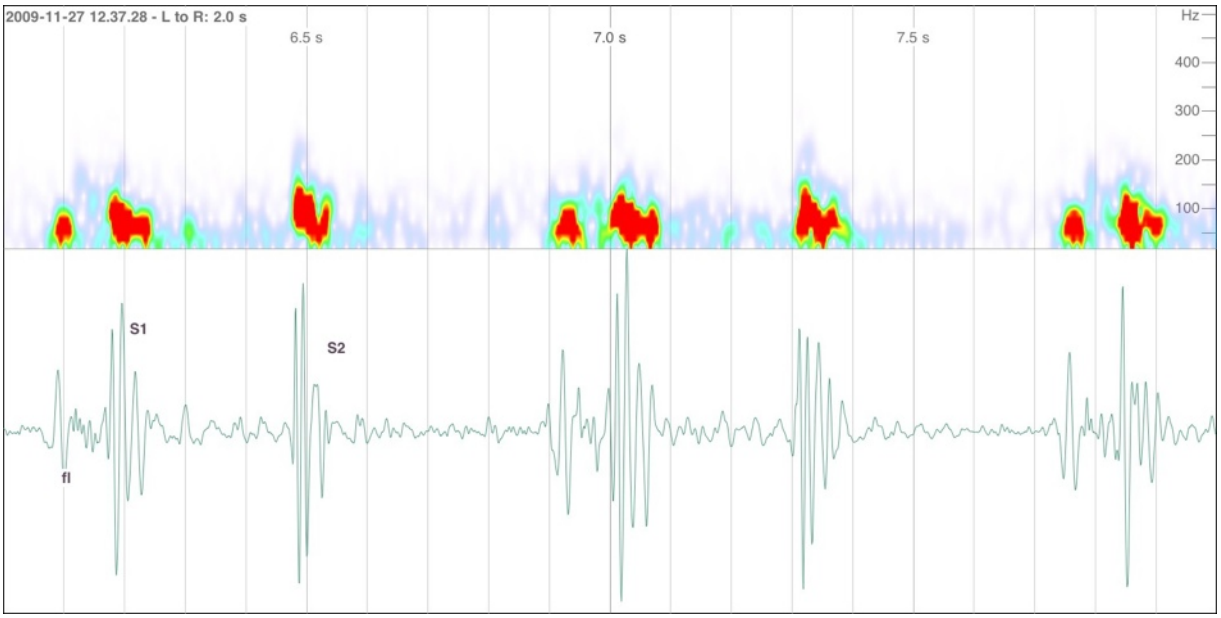
The difference between these two heart sounds is striking. Looking at the Power spectrum (the upper portion of the two graphs), notice that the normal heart sound has well-defined lower frequency S1 and S2 components. The rubbing sound of Pericarditis shows more high frequency components.

Review the included Reference sounds to further improve your understanding of Spectrograms and heart sounds.

Another way to understand the power spectrum is to run Stethoscope App without a stethoscope attached, and play a few notes on a piano. Middle C is 244 Hz, and playing that note will result in a distinct band across the middle of the power spectrum. Alternatively, vocalize tones from very low to very high and watch the bright regions change position from lower down on the screen to further up (higher frequency).



Emails include graphics ready for printing. Here an S4 sound is clearly seen before S1, and is flagged.

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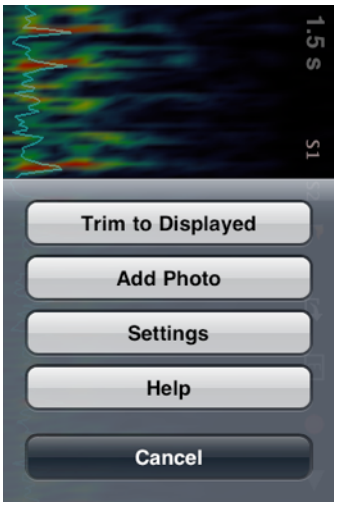
Adding Photos

You can add a few photos to a Recording to more completely document the case. This allows you to take an image of the subject, or perhaps a related document. (iPhone only.)

Added photos cannot be edited or deleted, however you can delete any email attachment prior to sending.

Photos are saved with the file when you save a file for later use.



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General Tips and Tricks

This list highlights quick and efficient ways to use Stethoscope App:

- To Zoom Out to the full recording, or Zoom In the previous zoom level, Double Tap!
- Pinch and Swipe your fingers to explore the Recording.
- Add ‘S1’, ‘S2’ and ‘Flag’ by Dragging them from the top of the screen.
- Delete Flags by Dragging them off the top of the screen.
- **Listen to Recordings** by connecting a suitable electronic stethoscope into the headphone jack, and pressing ‘Play’ . **Stethoscope App always loops through the sound shown on screen**.
- Save recordings for later playback. Add descriptive notes and titles.
- You can set up default Email addresses and note text emails. Since each email has a default title of the current date and time, these preferences can speed up email use. See Action > Email Settings.
- **Add photos** to any recording. This allows you to document the recording by taking a picture of the subject or by taking a picture of paperwork, etc. Edit > Add Photo (iPhone only).
- Stethoscope App includes a number of **Reference sounds** - open these with the ‘Action’ menu. When you Open a file, any existing recording that is not saved is discarded.
- To ‘start over’ - simply quit Stethoscope App and relaunch it. You can also swipe to the start of the sound, and press Record.
- Emails and saved files use the screen as shown on the screen to generate a phonocardiogram for emailing, so zoom to a definitive view before you Save or Email.
- The default email includes 2 - 3 phonocardiograms. You can increase this to show up to 5 images - see ‘Email Settings’.
- RMS power. The default display of Stethoscope App includes a simple plot of the sound Amplitude vs. Time. By selecting RMS power in Settings, Stethoscope App will show Power vs. Time. This can often be more useful when trying to spot subtle details.
- Trimming Recordings - After recording there will sometimes be some unwanted segment of the recording. Simply Pinch and Drag the display to show a desired segment, then Edit > Trim to Displayed to remove anything not displayed.
- To continue recording, press Record .Stethoscope adds a short silent gap, the continues recording. Consider Trimming the recording before continuing, to delete unwanted segments, however be careful not to trim desired sound.

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Support

Thinklabs offers support for all our products via our website: http://thinklabsmedical.com

Apps@thinklabsmedical.com

800.918.1088

303.220.9882

Please contact us with any product support questions. We try to respond to emails within a few hours, and email therefore provides the quickest response. You may also call us at 800-918-1088.

Address and Contact

Thinklabs Medical LLC
6571 South Pontiac Court
Centennial, CO 80111, USA

Data Security

Stethoscope generates data that is time stamped only. Users may add identifying personal information to recorded data. The safety and confidentiality of this data, and compliance with any applicable privacy laws, is the sole responsibility of the user of Stethoscope App.

Guidelines

In general, the iPod/iPhone is a much more ‘closed’ system than the typical computer system. This does provide a certain degree of data security compared to personal computers. However, mobile devices can be lost or stolen and the user should take appropriate steps to protect data and devices.

Any Saved files are backed up to any computer used to ‘sync’ the iPhone/Touch. Thus if identifying data is entered and saved with Stethoscope App, care must be taken to ensure the reliability and security of both the iPod/iPhone AND any computer to which it connects.

Emails are sent by Stethoscope App using the standard email system on the iPhone/Touch. This system can and should be set up to use security such as SSL to transmit email to a trusted email server.

Emails that have been generated by Stethoscope App but not yet sent will remain on the iPhone/Touch until they are sent. In addition, copies of sent emails are often kept in various ‘sent’ folders on various systems.

iPhones and iPods have various security features such as remote wipe (the ability to instruct a lost iPhone to erase all data), user passcodes (so that unwanted users cannot use an iPhone/Touch) and various encryption services. The iPhone 3Gs encrypts all data on the phone at all times. However, in many cases, it is the user’s responsibility to activate many of the features.

For additional information, please see the PDF available from Apple:
iPhone Security Overview

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Electrical Safety

When capturing sounds, ensure that all equipment is electrically floating i.e. disconnected from any mains-powered power supplies.

Disclaimer

Thinklabs Stethoscope App is intended for information gathering purposes only. The software is provided on an as-is basis. Stethoscope App includes no diagnostic algorithms or diagnostic indications. Using Stethoscope App for diagnostic purposes is entirely the responsibility of the end user. Medical diagnosis should be done exclusively by qualified and licensed medical professionals only.

Thinklabs Stethoscope App is not intended to be a substitute for professional advice and may not be used by for medical diagnosis. Extensive effort has been exerted to make this software as accurate as possible. This software is to be used as a guide only and healthcare professionals should use sound clinical judgement and individualize therapy to each specific patient care situation.

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